University of Bahrain

College of Information Technology
Department of Computer Science

ITCS252 Discrete Structures

First Semester 2013/2014

Final Exam – 2 Hours

STUDENT NAME	
STUDENT#	
SECTION#	
SERIAL#	

This exam contains 7 pages (including this cover page) and 8 questions. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You are allowed to use Calculators.

You *are not allowed* to use books, notes, or mobiles

Question	Points	Score
1	10	
2	10	
3	9	
4	10	
5	8	
6	7	
7	8	
8	8	
Total:	70	

Instructor: Dr. Ali Alsaffar Sections# 1 & 4
Dr. Yousif Al-Jazeeri Sections# 2, 3 & 5 (Coordinator)

(1) (a) **[2 points]** What is the contrapositive of $p \to (q \to r)$

(b) **[2 points]** What is the negation in English of "*Ahmed will not be happy unless he gets his degree*".

(c) **[2 points]** What is the converse of "*It is hot only if it is sunny*" in English.

(d) **[2 points]** What are the values of p, q, r, and s that make the statement $(p \wedge r \to \neg q) \to (q \to r \vee s)$ false.

Symbol	p	q	r	s
Value				

(e) **[2 points]** Write any statement in the conclusion of the below conditional statement to make it a tautology.

$$p \wedge \neg q \to \_\_\_\_\_$$

(2) Let $e(x)$: "x is even",
$p(x)$: "x is prime",
$s(x)$: "x is a perfect square"

Write the following in symbolic form using only the quantifiers $e(x), p(x)$, and $s(x)$, where the domain is **Z**, the set of all integers.

(a) **[2 points]** Some integers that are not primes are not perfect squares.

(b) **[2 points]** Any perfect square is not a prime.

(c) **[2 points]** A perfect square number is necessary for being odd.

(d) **[2 points]** No perfect square is even.

(e) **[2 points]** All even integers are neither perfect squares nor primes.

(3) [9 points] Using rules of inference show that the following argument is valid.

$$\begin{array}{l} p \rightarrow (q \rightarrow r) \\ p \vee s \\ t \rightarrow q \\ \neg s \\ \hline \therefore \neg r \rightarrow \neg t \end{array}$$

(4) [**10 points**] Prove by mathematical induction that $7^n - 2^n$ is divisible by 5, for any integer $n \geq 1$.

(5) **[8 points]** For any real numbers a, b, and c. If $a + b + c = 0$, prove that $b^2 - 4ac$ is a perfect square. Use *Direct Proof*.

(6) **[7 points]** For any sets A and B, prove that $(A - B) \cup (A \cap B) \subseteq A$.

(7) A relation R on $\mathbf{Z}$ is defined as

$$\forall a, b \in \mathbf{Z} : \ aRb \iff 3|a^2 - b^2$$

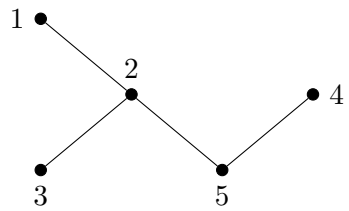
(a) **[6 points]** Show that R is an equivalence relation.

(b) **[2 points]** Find three elements of the equivalence classes [0] and [-1].

$[0] =$

$[-1] =$

(8) Consider the following Hasse diagram



(a) **[4 points]** Find the relation R.

$R =$ _____

_____

_____

(b) **[4 points]** Find the following:

Maximals = _____

Minimals = _____

Greatest = _____

Least = _____